

Claims

- [c1] 1. A method for filling intervals, comprising the steps of:
providing a substrate with a plurality of protruding structures thereon, wherein each protruding structure is separated from a neighboring protruding structure by an interval;
forming a first dielectric layer over the substrate to fill the intervals between the protruding structures and cover the protruding structures, wherein the first dielectric layer has a plurality of apertures positioned at a height level higher than a top section of the protruding structures;
removing a portion of the first dielectric layer and open up the apertures to form a plurality of openings;
performing an etching process to increase the width of the openings; and
forming a second dielectric layer over the first dielectric layer to fill the openings completely.
- [c2] 2. The method of claim 1, wherein the step for forming the first dielectric layer comprises performing a high-density plasma chemical vapor deposition process.
- [c3] 3. The method of claim 1, wherein the protruding struc-

tures comprises gate structures.

- [c4] 4. The method of claim 1, wherein the protruding structures comprises conductive line structures.
- [c5] 5. The method of claim 1, wherein the anisotropic etching process comprises a wet etching process performed using a hydrofluoric acid solution as an etchant.
- [c6] 6. The method of claim 1, wherein after providing a substrate but before forming the first dielectric layer over the substrate, further comprises forming a liner layer over the protruding structures and the substrate.
- [c7] 7. The method of claim 1, wherein removing the portion of the first dielectric layer further comprises performing a chemical/mechanical polishing operation.
- [c8] 8. The method of claim 1, wherein the etching process comprises an anisotropic etching operation.
- [c9] 9. A method for forming shallow trench isolation structures, comprising the steps of:
providing a substrate having a patterned pad oxide layer, a mask layer and a plurality of trenches thereon;
forming a first dielectric layer over the mask layer to fill the trenches, wherein the first dielectric layer has a plurality of apertures positioned at a height level higher

than an upper surface of the mask layer;
removing a portion of the first dielectric layer to open up the apertures and form a plurality of openings;
removing a section of the first dielectric layer off the sidewalls of the openings so that a width of the opening is increased;
forming a second dielectric layer over the first dielectric layer to fill the openings completely; and
removing the first dielectric layer and the second dielectric layer outside the trenches.

- [c10] 10. The method of claim 9, wherein the step for forming the first dielectric layer comprises performing a high-density plasma chemical vapor deposition process.
- [c11] 11. The method of claim 9, wherein the step for removing a portion of the first dielectric layer comprises performing a chemical/mechanical polishing operation.
- [c12] 12. The method of claim 9, wherein the step for removing a section of the first dielectric layer off the sidewalls of the openings comprises performing an anisotropic etching process.
- [c13] 13. The method of claim 12, wherein the anisotropic etching process comprises a wet etching process performed using a hydrofluoric acid solution as an etchant.

- [c14] 14. The method of claim 9, wherein after providing a substrate but before forming the first dielectric layer over the mask layer, further comprises forming a liner layer over the exposed surface of the trenches.
- [c15] 15. The method of claim 9, wherein after removing the first dielectric layer and the second dielectric layer outside the trenches, further comprises removing the mask layer and the pad oxide layer.
- [c16] 16. A method of filling intervals, comprising the steps of:
providing a substrate having at least a first opening thereon;
forming a first dielectric layer over the substrate to fill the first opening and cover the substrate, wherein the first dielectric layer has at least an aperture located above the opening at a height level higher than an upper surface of the substrate;
removing a portion of the first dielectric layer to open up the aperture and form a second opening;
removing a section of the first dielectric layer off the sidewalls of the second opening to increase a width of the second opening; and
forming a second dielectric layer over the first dielectric layer to fill the second opening completely.

- [c17] 17. The method of claim 16, wherein the step for forming the first dielectric layer comprises performing a high-density plasma chemical vapor deposition process.
- [c18] 18. The method of claim 16, wherein the step for removing a portion of the first dielectric layer comprises performing a chemical/mechanical polishing operation.
- [c19] 19. The method of claim 16, wherein the step for removing a section of the first dielectric layer off the sidewalls of the second opening comprises performing an anisotropic etching process.
- [c20] 20. The method of claim 19, wherein the anisotropic etching process comprises a wet etching process performed using a hydrofluoric acid solution as an etchant.
- [c21] 21. The method of claim 16, wherein the first opening comprises an interval between neighboring protruding structures.
- [c22] 22. The method of claim 16, wherein the first opening comprises a trench for forming a shallow trench isolation structure.